

Claims

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Hirama
5 1. A resonator structure (1200, 1300, 1400), where a certain wave mode is piezoelectrically excitable and which resonator structure comprises at least two conductor layers (110, 120) and at least one piezoelectric layer (100) in between the conductor layers, said conductor layers and piezoelectric layer extending over a first area of the resonator structure, which first area is a piezoelectrically excitable area of the resonator structure, characterized in that

- the resonator structure comprises a frame-like zone (2, 4) confining a center area (3),

10 - the center area is within the first area of the resonator structure,

- a cut-off frequency of the piezoelectrically excited wave mode in the layer structure of the frame-like zone is different from the cut-off frequency of the piezoelectrically excited wave mode in the layer structure of the center area, and

15 - width of the frame-like zone and acoustical properties of the layer structure in the frame-like zone are arranged so that displacement relating to the piezoelectrically excited strongest resonance mode is substantially uniform in the center area of the resonator.

2. A resonator structure according to claim 1, characterized in that the width of the frame-like zone is not uniform.

20 3. A resonator structure according to claim 1, characterized in that the cross-section of the frame-like zone is not uniform.

25 4. A resonator structure according to claim 1, characterized in that the frame-like zone has a substantially uniform width.

5. A resonator structure according to claim 4, characterized in that the cross-section of the frame-like zone is substantially rectangular.

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30 6. A resonator structure according to claim 4, characterized in that the width of the frame-like zone and the cut-off frequency in the layer structure of the frame-like zone are arranged so that a lateral resonance frequency in infinitely long rectangular resonator, whose width is twice the width of the frame-like zone, where the cut-off frequency is the same as the cut-off frequency in the layer structure in the frame-like zone and which is surrounded by the layer structure of the area surrounding the frame-like zone, is substantially the same as the cut-off frequency in the center area.

- ① 7. A resonator structure (1230) according to claim 1, characterized in that the frame-like zone is substantially circular.
- ① 8. A resonator structure (1220) according to claim 1, characterized in that the frame-like zone is substantially polygonal.
- ① 9. A resonator structure (1210) according to claim 8, characterized in that the frame-like zone is substantially rectangular.
- ① 10. A resonator structure according to claim 9, characterized in that the cross-section of the frame-like zone is substantially rectangular.
- ① 11. A resonator structure (820, 840, 850) according to claim 1, characterized in that the cut-off frequency of the piezoelectrically excited wave mode in the layer structure of the frame-like zone is higher than the cut-off frequency of the piezoelectrically excited wave mode in the layer structure of the center area.
- ① 12. A resonator structure according to claim 11, characterized in that the dispersion of the piezoelectrically excited wave mode is of type II in the frame-like area.
- ① 13. A resonator structure (810, 830, 860) according to claim 1, characterized in that the cut-off frequency of the piezoelectrically excited wave mode in the layer structure of the frame-like zone is lower than the cut-off frequency of the piezoelectrically excited wave mode in the layer structure of the center area.
- ① 14. A resonator structure according to claim 13, characterized in that the dispersion of the piezoelectrically excited wave mode is of type I in the frame-like area.
- ① 15. A resonator structure (1000, 1300, 1700, 1820) according to claim 1, characterized in that the frame-like zone is within the first area.
- ① 16. A resonator structure according to claim 1, characterized in that the frame-like zone is at least partly outside the first area.
- ① 17. A resonator structure (1810, 1820) according to claim 1, characterized in that at least one of the layers of the resonator has a first part, which is patterned, and a second part, which consists of is a uniform thin film.

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(15) (18) 18. A resonator structure (1810) according to claim 17, characterized in that the first part is a rim covering the frame-like zone.

(17) (14) 19. A resonator structure according to claim 18, characterized in that the layer having the first part and the second part is a top electrode of the resonator structure.

(15) 5 20. A resonator structure (1820) according to claim 17, characterized in that the second part covers the frame-like zone.

(17) 21. A resonator structure according to claim 20, characterized in that the layer having the first part and the second part is a passivation layer of the resonator structure.

(1) 10 22. A resonator structure (1710) according to claim 1, characterized in that
- the thickness of the center area is substantially uniform,
- the thickness of a region surrounding the frame-like zone is substantially uniform at a certain region next to an interface between the frame-like zone and the surrounding region, and
15 - the thickness of the frame-like zone varies over the width of the frame-like zone.

(17) (14) 23. A resonator structure according to claim 22, characterized in that the frame-like zone is thicker at an interface between the center area and the frame-like zone than at the interface between the frame-like zone and the surrounding material.

(1) 20 24. A resonator structure according to claim 22, characterized in that the frame-like zone is thinner at the interface between the center area and the frame-like zone than at the interface between the frame-like zone and the surrounding material.

(17) 25. A resonator structure (1400) according to claim 1, characterized in that in the frame-like zone a first layer (120) extending at least over the center area and the frame-like zone overlaps with a second layer (140) extending over the frame-like zone and over some part of the area surrounding the frame-like zone.

(17) 26. A resonator structure according to claim 25, characterized in that the first layer is one of the conductor layers and the second layer is a passivation layer.

(1) 27. A resonator structure (1300) according to claim 1, characterized in that it comprises at least one frame-like layer, which forms the frame-like zone.

(17) 30 28. A resonator structure (1000) according to claim 1, characterized in that the frame-like zone is arranged by varying the thickness of at least one of the layers

extending at least over the frame-like zone and the center area, so that the thickness of said layer is different in the frame-like zone than in the center area.

29. A resonator structure according to claim 28, characterized in that said layer is a top electrode (120) of the resonator structure.

30. A resonator structure according to claim 28, characterized in that said layer is thicker in the frame-like zone than in the center area.

31. A resonator structure according to claim 28, characterized in that said layer is thinner in the frame-like zone than in the center area.

32. A resonator structure according to claim 1, characterized in that it is a thin film bulk acoustic wave resonator.

33. A resonator structure according to claim 1, characterized in that the thickness of the resonator structure in the center area is substantially uniform.

34. A resonator structure according to claim 1, characterized in that the thickness of the resonator in the center area is different in a first part of the center area than in a second part in the center area.

35. A filter comprising at least one resonator structure (1200, 1300, 1400), where a certain wave mode is piezoelectrically excitable and which resonator structure comprises at least two conductor layers (110, 120) and at least one piezoelectric layer (100) in between the conductor layers, said conductor layers and piezoelectric layer extending over a first area of the resonator structure, which first area is a piezoelectrically excitable area of the resonator structure, characterized in that

- the resonator structure comprises a frame-like zone (2, 4) confining a center area (3),
- the center area is within the first area of the resonator structure,

- a cut-off frequency of the piezoelectrically excited wave mode in the layer structure of the frame-like zone is different from the cut-off frequency of the piezoelectrically excited wave mode in the layer structure of the center area, and

- width of the frame-like zone and acoustical properties of the layer structure in the frame-like zone are arranged so that displacement relating to the piezoelectrically excited strongest resonance mode is substantially uniform in the center area of the resonator.